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ABSTRACT

The effects of persistence on students' ability to interact and learn in cooperative learning groups was studied, and the effect of collaboration on students' attitudes toward their partners was assessed. Participants were 138 sixth graders in a midwestern public school. A computer-based lesson and posttest dealt with the advertising concepts of bandwagon, uniqueness, testimonial, and transfer. Persistence was assessed by measuring the number of options students selected in the lesson. Students completed the lesson alone and in cooperative groups. Results suggest that, although persistence did not affect achievement in this study, it did influence the amount and nature of interaction in groups. Average persisters interacted more frequently than did high or low persisters, possibly because they are more able, and less apprehensive about verbal interaction than other students. Average persisters evidently use their better developed metacognitive skills to judge the optimum level of effort to invest. Students were more likely to name an individual as a desirable partner after collaborating. The type and frequency of interaction among different levels of persisters warrants further investigation. (Contains 31 references.) (SLD)

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Persistence and Small Group Interaction

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Persistence and Small Group Interaction

One approach to designing computer-based instruction (CBI) involves using the adaptive capabilities of the computer to provide individualize instruction (Kinzie, 1990; Carrier & Jonassen, 1988; Tennyson & Park,1987; Reiser,1987). However, practical limitations, such as the extensive time requirements and associated financial costs, limit the potential for individualizing CBI (Carrier & Jonassen, 1988, Bork, 1987). Another limiting factor is the shortage of computers and subsequent logistical constraints endured by most schools. In practice, most students work in groups, not alone, at the computer (Becker, 1986; Hooper, 1993).

Focusing on individualized CBI also ignores consistent research findings that demonstrate the effectiveness of cooperative learning methods on student achievement, their attitudes towards instruction, and other students (Johnson, Johnson, & Maruyama, 1983; Johnson & Johnson, 1991; Slavin, 1991). Furthermore, a growing body of evidence has accumulated which indicates similar benefits for completing CBI in cooperative learning groups (Johnson, Johnson, & Stanne, 1985, 1986; Dalton, Hannafin, & Hooper, 1989; Hooper, 1992; Light & Blaye, 1990; Nastasi & Clements, 1991; Jackson, Fletcher, & Messer, 1992).

From a design perspective, however, the pertinent issue no longer appears to be whether cooperative CBI benefits student achievement, but rather involves identifying factors which affect group performance. Perhaps the most important determinants of group performance are the quality and quantity of student interaction. Webb (1982b, 1985) found that student achievement benefits from frequent intra-group interactions which include both the giving and receiving of elaborated explanations which go beyond mere "terminal help". It is important, therefore, to recognize that the nature of intra-group interaction is likely to be a direct reflection of the internal dynamics within the group.

One factor that appears to influence the nature of interaction is ability grouping. Webb's research indicates the positive achievement affect that heterogeneous ability grouping has on high- and low-ability students, but not average students (1982a,b). In Webb's studies, when grouped heterogeneously, average ability students were frequently excluded from the peer tutoring relationships that often existed between high- and low-ability students. In other studies, heterogeneous-ability grouping benefitted the performance of low-ability students, but high-ability students did best when grouped homogeneously (Hooper & Hannafin,1988; Hooper, 1991).

Ability grouping influences the quantity and quality of interaction. Low-ability students interact more frequently and effectively when grouped heterogeneously by ability, but high-ability students interact equally effectively in homogeneous and heterogeneous ability groups. The rate of interactions decreases for low-ability students who are homogeneously grouped (Hooper & Hannafin, 1991), but increases for high-ability students who are homogeneously grouped (Hooper, 1992).

In addition to ability grouping, several other individual factors or personality characteristics may affect the intra-group dynamics. One such factor is a student's task persistence level. In a study of the affects of learner control on student performance, Carrier & Williams (1988) found a curvilinear relationship between an individual student's task persistence and subsequent achievement. Medium task persisters demonstrated higher achievement than both extremely low and high persisters. When given control of the amount and nature of instruction and practice to receive during CBI, high persisters persevered even though they know the material; their persistence, similar to the effects seen in high motivation or arousal (Yerkes & Dodson, 1908) apparently inhibited their learning. Low persisters stopped studying the lesson material prematurely, believing that they had sufficiently mastered the lesson content.

To date, however, the effects on performance of grouping students according to individual variations in persistence levels have not been investigated. In the present study we examined how homogeneous and heterogeneous groupings of individual persistence levels affected group performance and interaction patterns. We were interested in whether the presence of an average persister would enhance the performance of the high or low persisters, or conversely whether high or low persisters would detract from the performance of the average persisters. We were also interested in the affect of grouping on two other outcomes: students' attitudes and intra-group interaction. In particular, we were interested in examining the impact of collaboration on students' selection of cooperative learning partners and in examining how student interaction varied as a function of group composition.

Methods

Subjects

Participants in the study were 139 sixth grade students enrolled in five classes at a Midwestern public school. Of the total number, 68 students were male and 71 were female. One student was not paired, and was removed from the data being analyzed, leaving 138 students in the study.

Materials

The computer-based lesson and posttest were based on those used in previous research by Carrier and Williams (1988). The lesson content introduces four advertising concepts: bandwagon, uniqueness, testimonial and transfer. The lesson begins with a concept definition followed by a set of expository examples and nonexamples. Next, students attempt practice questions and choose whether to receive related feedback indicating the accuracy of their responses and elaborated feedback emphasizing the presence or absence of critical attributes. Students also decide whether to attempt additional practice items. The original materials were modified to include a maximum of six questions for each concept. Thus, for each concept students could select up to 18 options including examples, feedback and elaboration.

The lessons were presented in three segments. The first concept was used to assess students' levels of persistence. This lesson was completed individually by all students. Concepts two and three were presented on the second day and were completed in cooperative groups. Concept four was presented on the third day and was again completed in groups.

The posttests were designed to measure students' achievement and attitudes toward their partners. The achievement posttest includes two parts: twenty-five questions measure comprehension of the lesson material and four problem solving questions measure higher levels of cognitive processing. Comprehension questions involve classifying instances of the lesson concepts. Problem solving questions involve generating instances of lesson concepts. Coefficient-alpha reliability for the posttest was .91. The Partner Preference Questionnaire asks students to list the names of up to five students from their class class with whom they would like to work.

The interaction rate was determined by dividing the total number of instances of cooperative behavior by the total time an individual was observed. Thus, the interaction rate represents the average number of interactions per minute. Interaction was observed and coded by trained raters. The number of student groups active during each session was greater than the number of trained raters available. Consequently, we observed all groups by rotating raters during the lesson. Raters rotated every five minutes to reduce coding variation. Furthermore, approximately 40% of the groups were videotaped during the instruction to facilitate a qualitative analysis.

Before the study, raters were trained in observation and coding techniques. Rater training consisted of three stages. First, the lesson was videotaped with a comparable group of students. The videotapes of the pilot session were used to develop the coding instrument. The second stage of rater training involved training eight graduate students who had volunteered to be raters during the study. The raters were trained using a combination of discussion, tape review, and practice. During practice, individual rating differences led to review of tape segments and group discussion. The third stage involved testing raters performance to confirm consistency in the ratings given by the observers. The individual who conducted a post hoc videotape analysis was trained using similar processes.

Procedures

Students completed a 90 minute workshop, lead by the investigators, before the study. The purpose of the workshop was to enhance intra-group interaction and cooperation. The activities employed in the training session are outlined elsewhere (Hooper, Temiyakarn, & Williams, 1993). One week later, all students completed a computer based lesson alone. The purpose of the lesson was to assess student persistence. Based on the total number of options selected during the lesson, students were classified as High (H), Average (A), or Low (L) in terms of persistence.

Before working in groups, students completed the Partner Preference Questionnaire. Next, dyads were formed by randomly assigning students within each class to a dyad resulting in six possible combinations of persistence (HH, HM, HL, MM, ML and LL). Students completed the remaining three computer based lessons in groups over two successive days. One week later students completed the posttest and the Partner Preference Questionnaire.

Design and Data Analysis

Dependent measures included Interaction Rate, Achievement (divided into Concept Learning and Problem Solving), and Attitudes. A MANOVA was conducted using Interaction Rate and the two achievement measures as dependent variables. Independent variables included Persistence Level (High, Average, and Low), Gender (Male and Female), and Mix (Heterogeneous and Homogeneous). Significant overall effects were followed up with univariate ANOVA's. A separate 2X2 Chi square analysis was conducted on the Partner Preference Questionnaire. Independent variables were Time (Pretest and Posttest) and Partner Selection (Yes or No). Calculations were made using Systat (© 1990, SYSTAT, Inc.), and Testat, (© 1986, SYSTAT, Inc.). All tests of significance adopted an alpha level of .05.

Results

Posttests.

Table 1 reports the means and standard deviations on the posttests. A MANOVA on these data indicated significant effects for Persistence Level [Wilks' Lambda = .883, $F(6,226) = 2.42$, $p<.02$] and for Gender [Wilks' Lambda = .933, $F(3,113) = 2.70$, $p<.05$]. No other effects were statistically significant.

Univariate follow-up tests indicated that Persistence Level was significantly related to Interaction Rate [$MS_{Error} = 1.653$, $F(2,115) = 4.71$, $p=.011$]. Average persisters interacted significantly more that high and low persisters (see means on Table 1).

Follow-up examination of the Gender effect indicated that Gender was significantly related to Concept Learning [MS_{Error}= 43.57, $F(1,115)$= 4.55, p=.035] and to Problem Solving [MS_{Error}= 1.87, $F(1,115)$= 6.84, p=.010]. In each case, males outperformed females (Concept Learning 15.81 vs. 13.23; Problem Solving 2.52 vs. 1.80).

Insert Table 1 about here

Interaction

A post hoc analysis of videotapes recorded during the experiment was conducted to validate the rating procedure conducted during the experiment. During the study all groups were rated by trained observers, but the post hoc analysis was conducted on only a subset of the groups. Comparison of these data indicated a strong relationship between the social interaction ratings that occurred during and after the study (r = 0.75, p < .001).

Attitudes

The Partner Preference Questionnaire showed a significant increase in the number of students who included their partner (Chi-Square = 37.0, p <.01). Before the experiment, eighteen students included their eventual partners on the Partner Preference Questionnaire. Following the experimental treatments, twenty-three more students listed their assigned partners as a preferred partner while only two people removed their partner from the list. In one of the two cases, in which the partner was initially listed but was not listed following the experimental treatment, notes recorded during the experiment indicate that strong negative social interaction occurred between the partners at the beginning of the first day.

Correlation Analyses

Correlations between Interaction Rate and overall achievement were analyzed to determine the relationship between collaboration and achievement (r = .20, p =.024). Furthermore, correlations between Interaction Rate and overall achievement were further examined to determine whether the relationship varied according to Persistence Level. This analysis indicated that the relationship was significant only for the low persisters (r = .47, p =.003).

Discussion

The purpose of this study was to examine the effects of persistence on students' ability to interact and learn in cooperative learning groups. In addition, the study assessed the effect of collaboration on students' attitudes toward their partners. Results indicate that although persistence did not affect achievement, persistence did influence the amount and nature of interaction in groups.

Average persisters interacted more frequently than did either high or low persisters. One possible explanation for this finding is that average persisters are more able and consequently less apprehensive about verbal interaction than other students. Carrier and Williams (1988) found a curvilinear relationship between persistence and achievement indicating that average persisters are more able than high and low persisters. Average persisters apparently used their better developed metacognitive skills to judge the optimum level of effort to invest. Higher metacognitive ability may also increase self-efficacy, allowing individuals to benefit from group activities. Students who display characteristics of low apprehension "... have well developed social skills, are outgoing, enterprising, original, verbally fluent, and fluent in thought. They possess self-assurance, and are spontaneous, expressive, and enthusiastic." (Bouchard, 1969). Consequently, students with higher levels of metacognitive ability may be more willing to engage in group interaction.

As expected, a significant positive relationship was found between the positive verbal interaction rate and achievement. However, the magnitude of the relationship is lower than that observed during other studies (e.g. Hooper, 1991; Webb, 1982c). Further

investigation revealed that the relationship between verbal interaction and achievement was significant for low persistence students only. Even though low persisters interacted significantly less than average persisters, the interaction rate was a much better predictor of success for low persisters than for others.

The results of the Partner Preference Questionnaire were particularly interesting. Students were asked on two occasions to name up to five class members with whom they would like to work in a cooperative group. The first occasion was before students had completed any of the lesson materials and the second was immediately before completing the posttest. Two students who originally named their partner did not rename that individual on the follow-up survey. However, twenty-three students who did not originally name their partners did so following the group activity. In other words, an individual was significantly more likely to be named as a desirable partner after collaborating. This results support the notion that collaboration breaks down social barriers and helps to improve interpersonal relations among students. Similar results have been observed in many other cooperative learning studies. For example, Sharan and his associates (Sharan, 1980; Sharan, Kussell, Sharan, & Bejarano, 1984) have reported that cooperative learning improves students' self esteem and their attitudes toward peers and school work. Similarly, Johnson and Johnson (1989) indicated that promotive interaction among partners during cooperative learning produces a positive psychological climate and increases attraction toward one another.

Many teachers use cooperative learning to improve students' attitudes toward each other. However, the result of the present study is noteworthy because of the limited exposure to partners experienced by participants. Students worked with their partners on two occasions, generally for less than one hour in total. Apparently, even limited exposure to other students in a meaningful learning environment has the potential to enhance students attitudes toward each other.

Further research is needed to examine how students attitudes toward their partners evolve. One common approach employed by teachers involves changing group members frequently to avoid potential conflict between members. Yet, in practice, groups may become more cohesive and effective with experience. Charrier (1972) outlined a model of group development through which effective groups pass. Groups typically move through five stages of development: forming, storming, norming, performing, and adjourning. Storming is perhaps the most significant evolutionary stage, because by expressing and working through this stage of intense conflict, group members begin to assume the responsibility of managing the intra-group functions and dynamics (McClure, Miller, & Russo, 1992).

In the present study many partners apparently warmed-up to each other during the second day and became very active in their verbal elaboration of the content. For example, one group that began negatively appeared to work through their differences. One student dominated the mouse at the beginning of the first lesson and refused to select additional examples despite her partner's protest. However, the more persistent partner continued to seek elaborative information and the previously negative partner appeared to develop greater interest in the lesson content.

Furthermore, students attitudes toward their partners are likely to reflect the quality of intra-group interaction. Nine of the interaction rating forms included comments from raters concerning how well the members were elaborating on the lesson content. These nine groups contributed six of the twenty-three posttest partner preference conversions discussed previously.

Not all interactions within groups were positive. Despite being given explicit instructions and practice in how to interact in groups, some partners did not interact effectively. Indeed, some students were openly hostile toward their partners on both days. For example, on the first day one group member only pointed at the computer screen and did

not interact verbally. On the following day, the silent member did not consult his partner and said loudly "Don't" when his partner tried to use the keyboard and then dominated the mouse and keyboard during the rest of the lesson. Students who fail to interact effectively are less likely to reap the potential affective benefits of cooperative learning.

Unexpectedly, the study also produced a gender effect for achievement. Males scored significantly higher on both posttests than did females. One possible explanation for this finding concerns the males' tendency to dominate the learning environment. Informal observations of the videotapes indicated that males tended to monopolize the computer and keyboard. For example, in one case, objections from a female were ignored by the male until the lesson was virtually complete. If these limited observations reflect a practice that occurred throughout the study, then females may have been alienated toward the lesson resulting in poor encoding of lesson content and poor posttest achievement.

Further research is needed to analyze intra-group interaction. Dynamic group interaction is difficult to measure accurately. In the present study, video tapes of the group sessions provided an opportunity for in depth observations. In future, however, research approaches that emphasize qualitative methodologies may be particularly helpful.

Further research is needed to test the hypothesis that grouping negated the effects of persistence. Although the initial persistence scores of students working alone appear to be very similar to those obtained in the original study, achievement scores failed to replicate the curvilinear relationship between persistence and achievement found by Carrier and Williams (1988). Furthermore, the type and frequency of interaction among different levels of persisters warrants further investigation.

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Table 1. Means and Standard Deviations by Persistence Level

		Information Rate	Concept Learning	Problem Solving
Persistence Level				
High				
Heterogeneous	M	2.68	13.64	2.08
	SD	1.28	7.23	1.38
	N	25	25	25
Homogeneous	M	2.55	15.89	2.57
	SD	1.09	6.65	1.40
	N	26	28	28
Total	M	2.62	14.83	2.34
	SD	1.18	6.95	1.40
	N	51	53	53
Average				
Heterogeneous	M	3.26	15.04	2.19
	SD	1.48	6.39	1.30
	N	26	26	26
Homogeneous	M	3.43	12.13	1.88
	SD	1.35	6.55	1.63
	N	16	15	16
Total	M	3.33	13.98	2.07
	SD	1.41	6.52	1.42
	N	42	41	42
Low				
Heterogeneous	M	2.67	15.44	2.22
	SD	1.13	6.00	1.54
	N	23	23	23
Homogeneous	M	2.62	13.81	1.75
	SD	1.26	7.38	1.48
	N	16	16	16
Total	M	2.65	14.77	2.03
	SD	1.17	6.56	1.51
	N	39	39	39